

Climate Change and the Pacific Northwest Coastal Ocean

BY

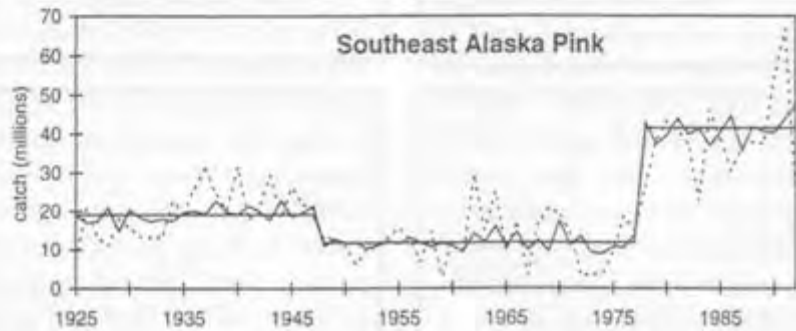
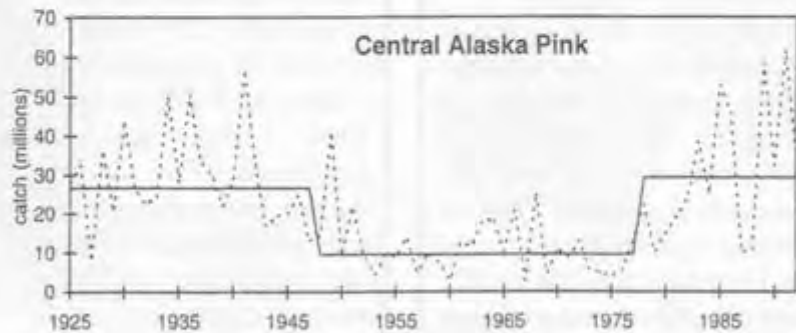
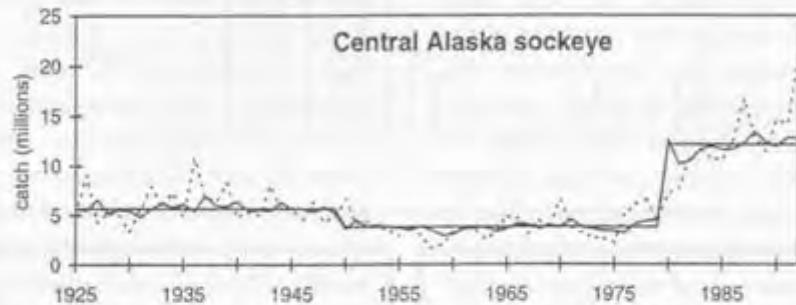
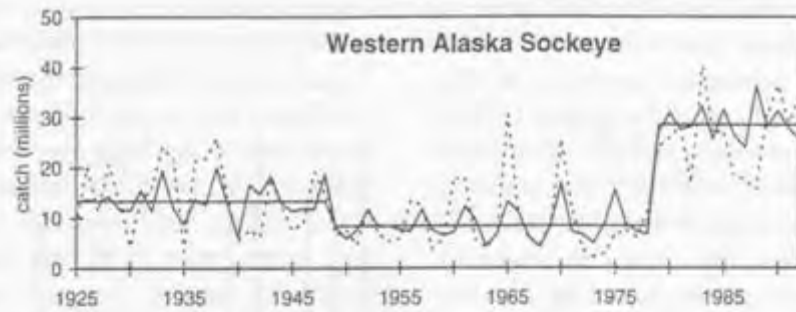
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Seattle, WA 981954

- Climate clearly has an impact on valuable PNW coastal marine resources
- Effects occur at the ecosystem scale
- Some recent observations in the coastal ocean
- Climate change and what to do about it?

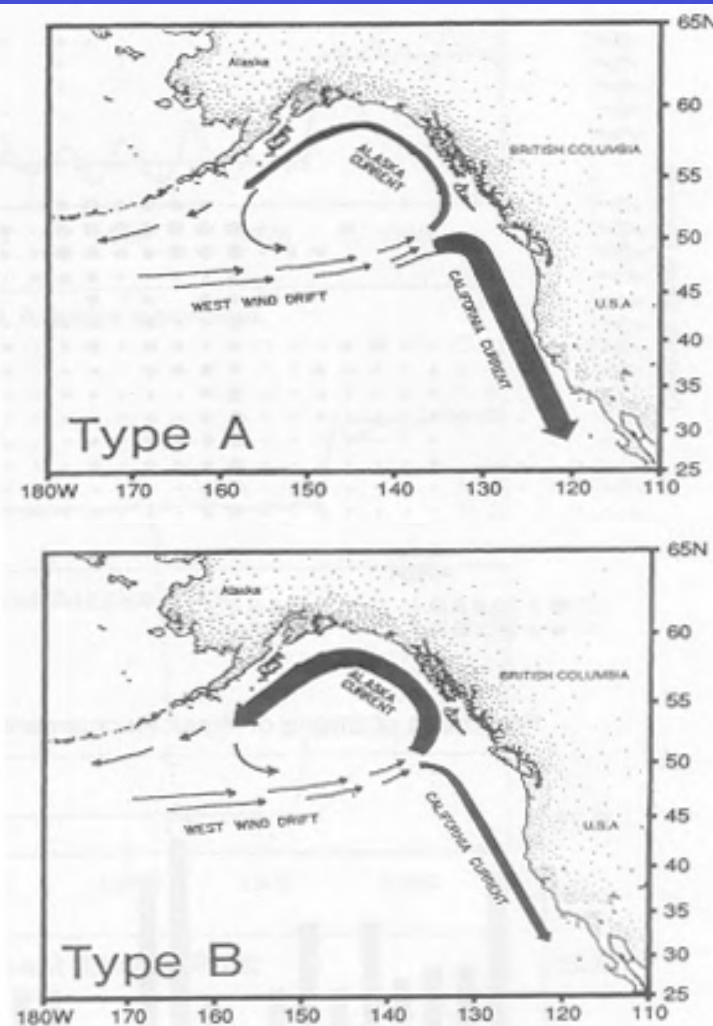
Salmon and Climate:

This is where it all started

Hollowed and Wooster 1994



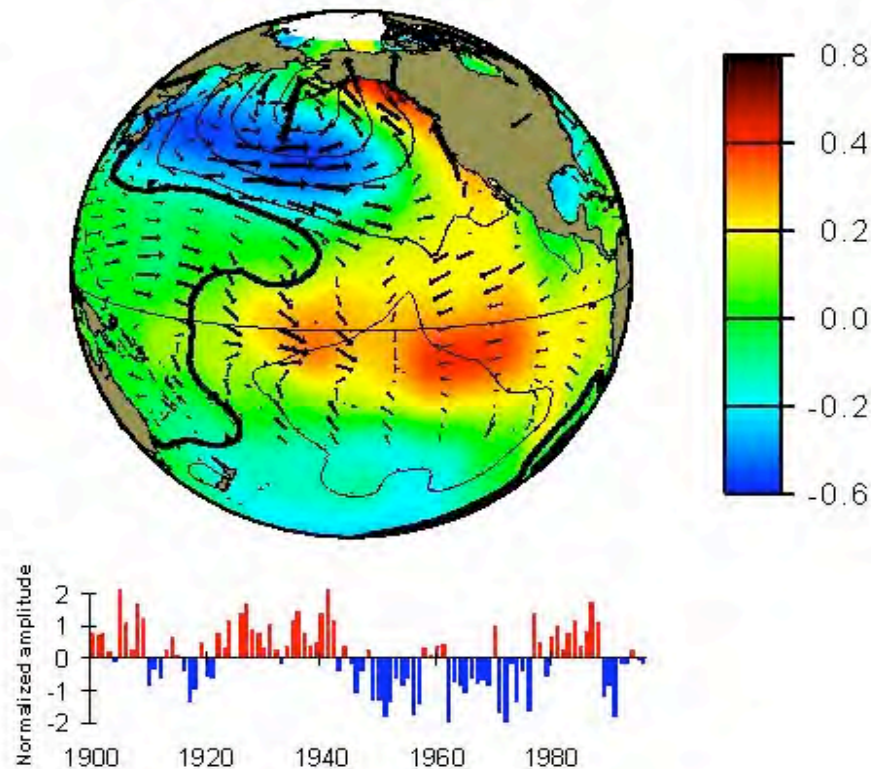
Francis and Hare 1994



Alaska and PNW salmon production are out of phase

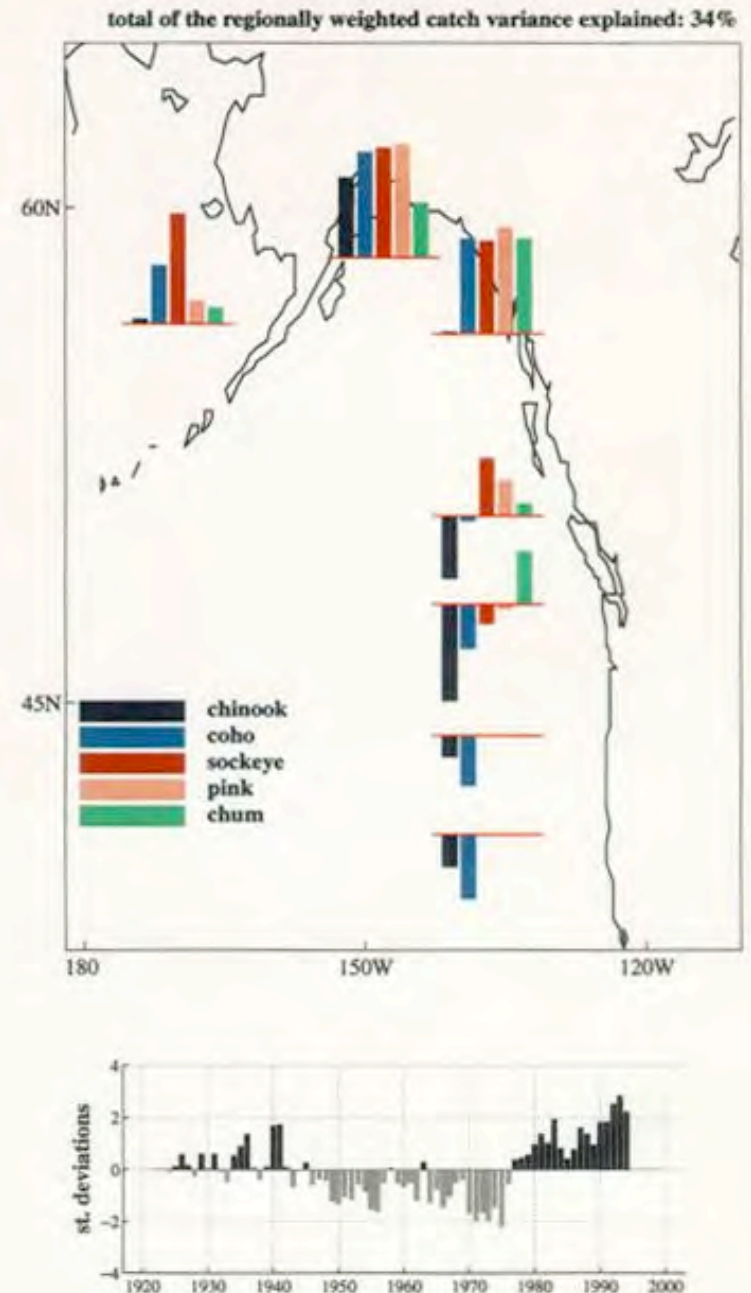
Mantua et al 1997

Pacific Decadal Oscillation

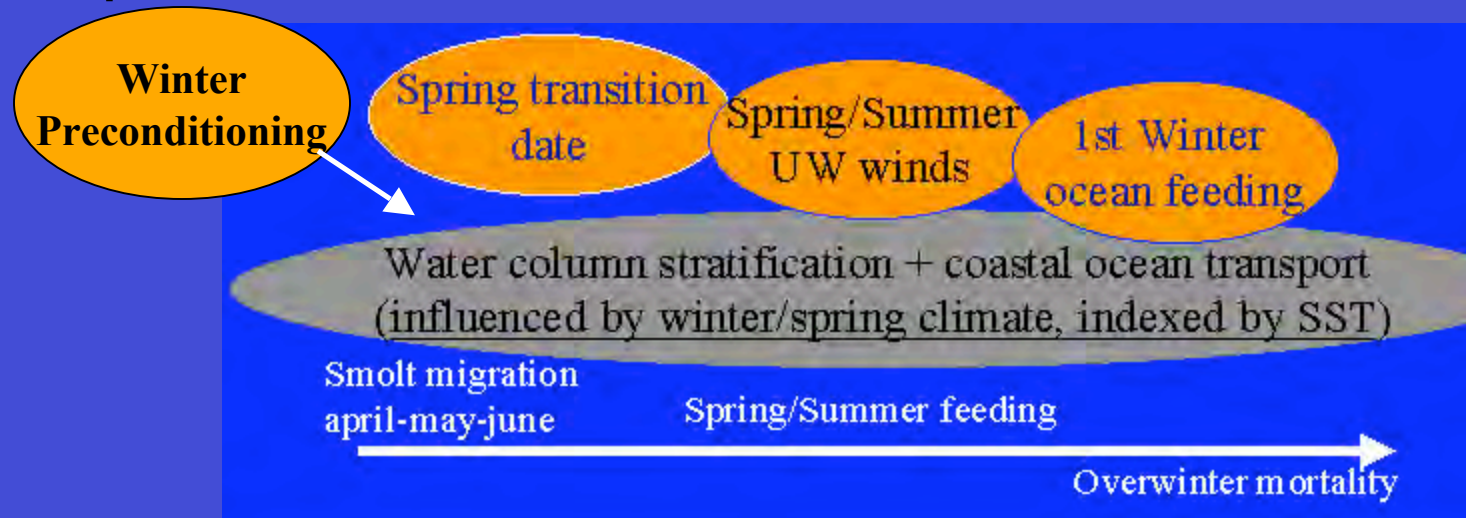


Hare et al 1999

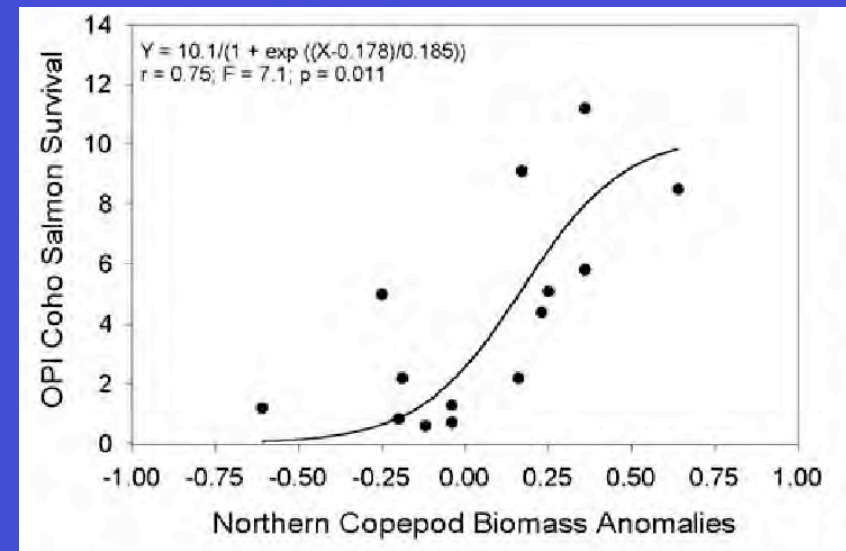
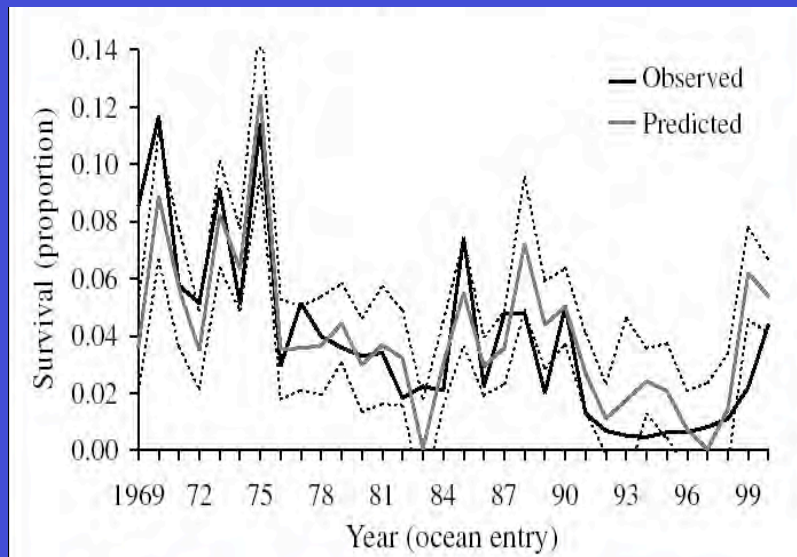
Leading EOF of NE Pacific salmon landings: 1925-1997



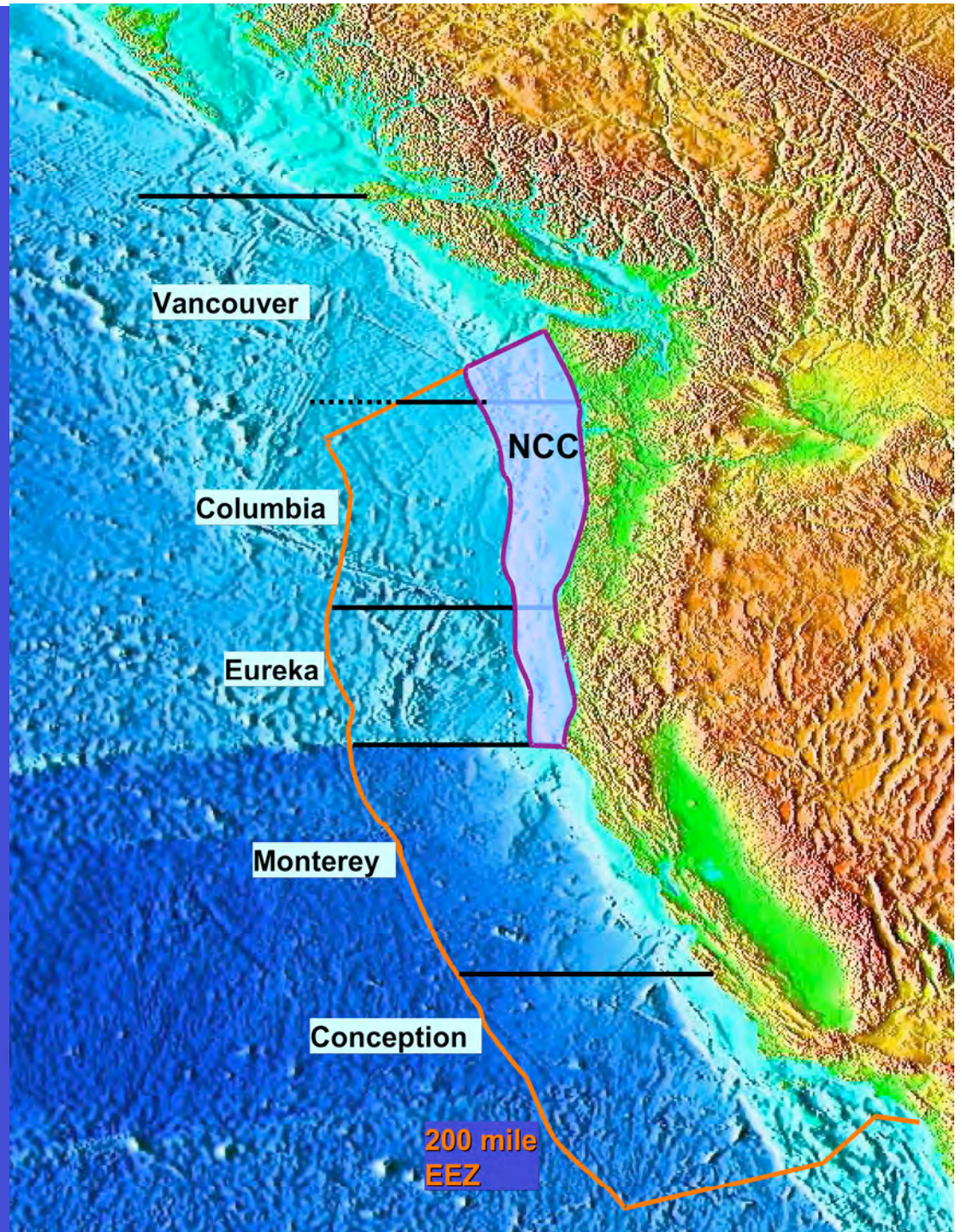
Logerwell et al. (2003) found that Oregon coastal coho salmon survival was influenced by a series of (mostly) independent physical ocean processes..



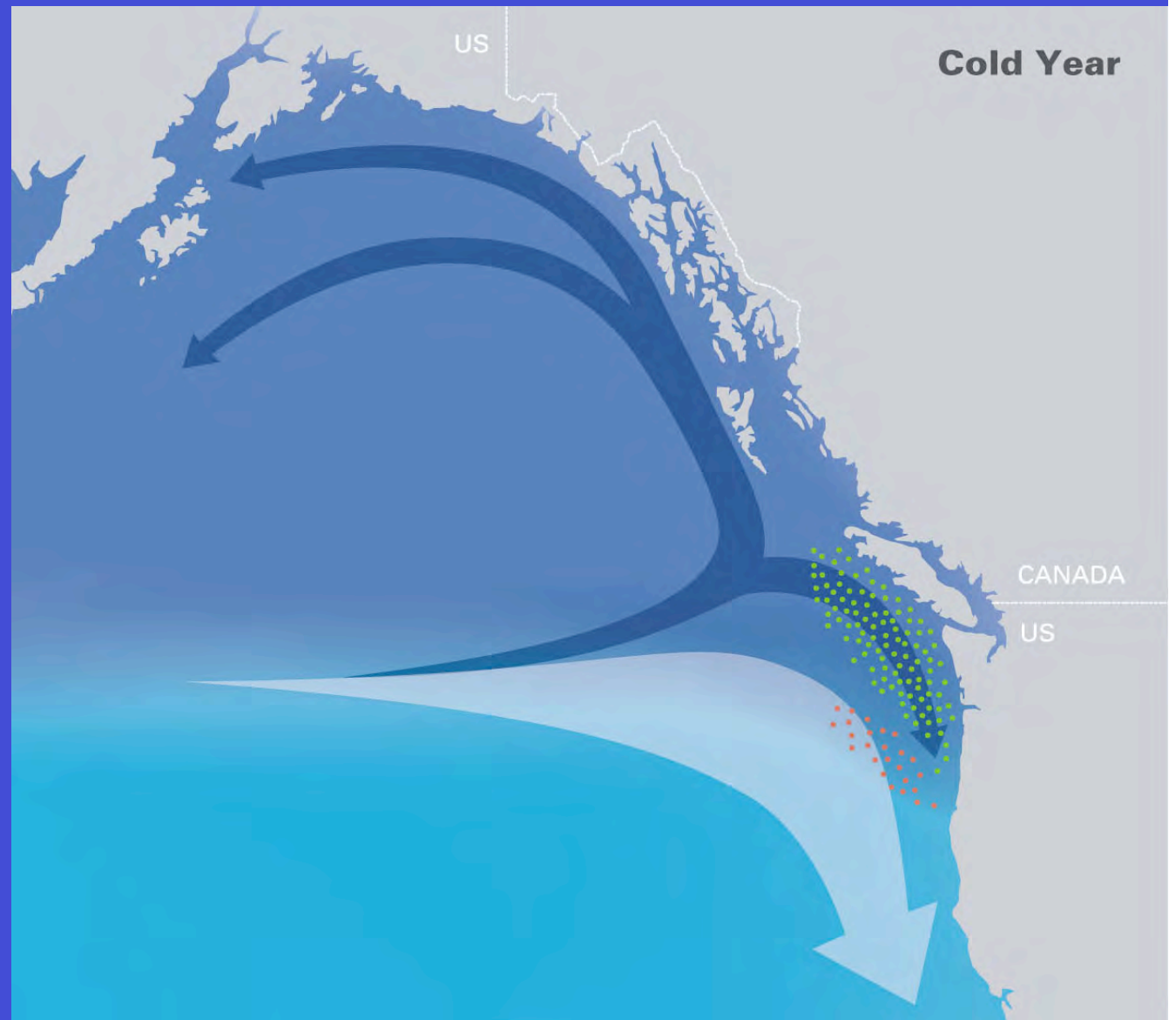
Peterson & Schwing 2004



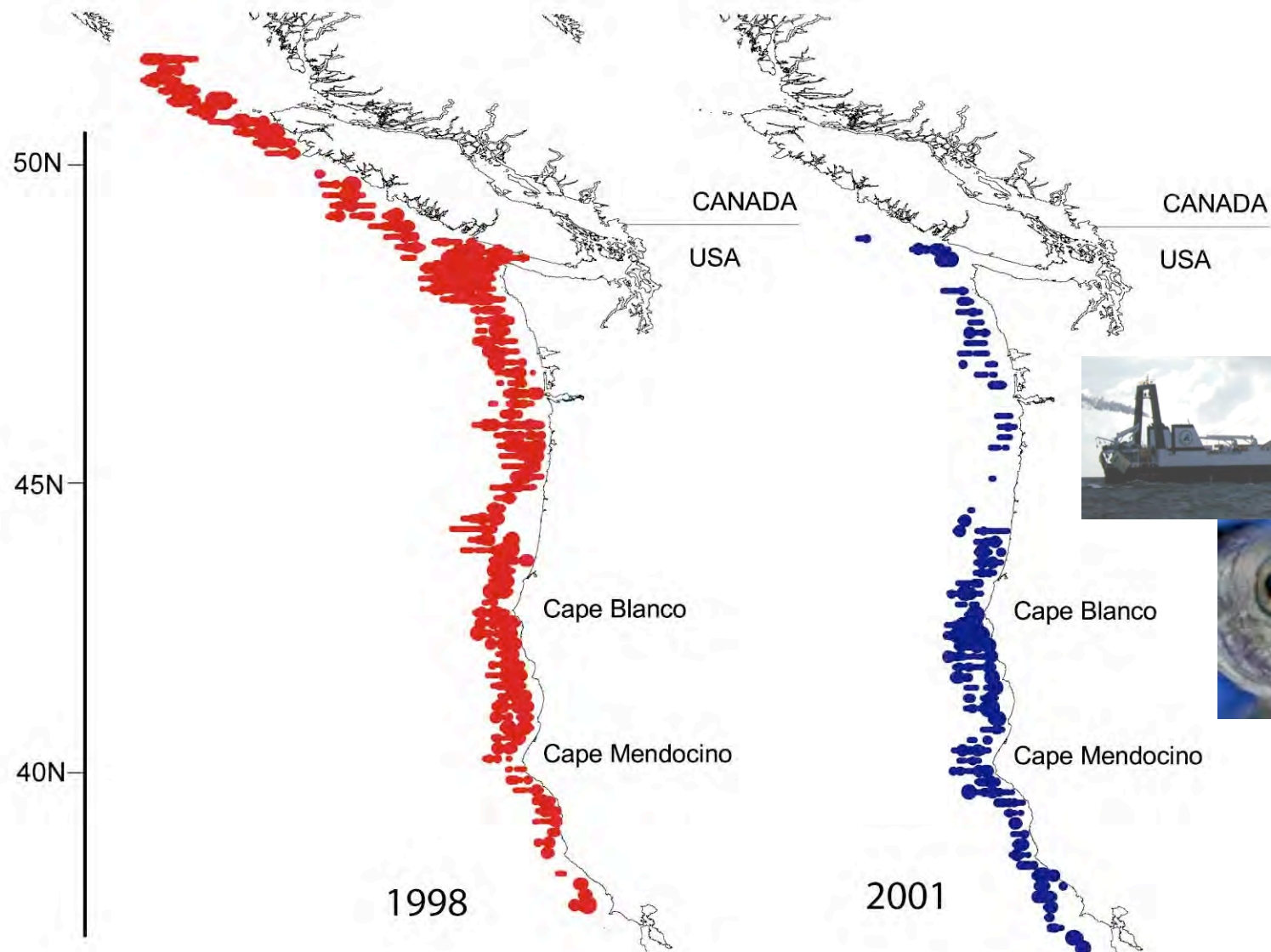
Northern California Current (NCC) Ecosystem



Climate drives
the system from
the bottom up ...



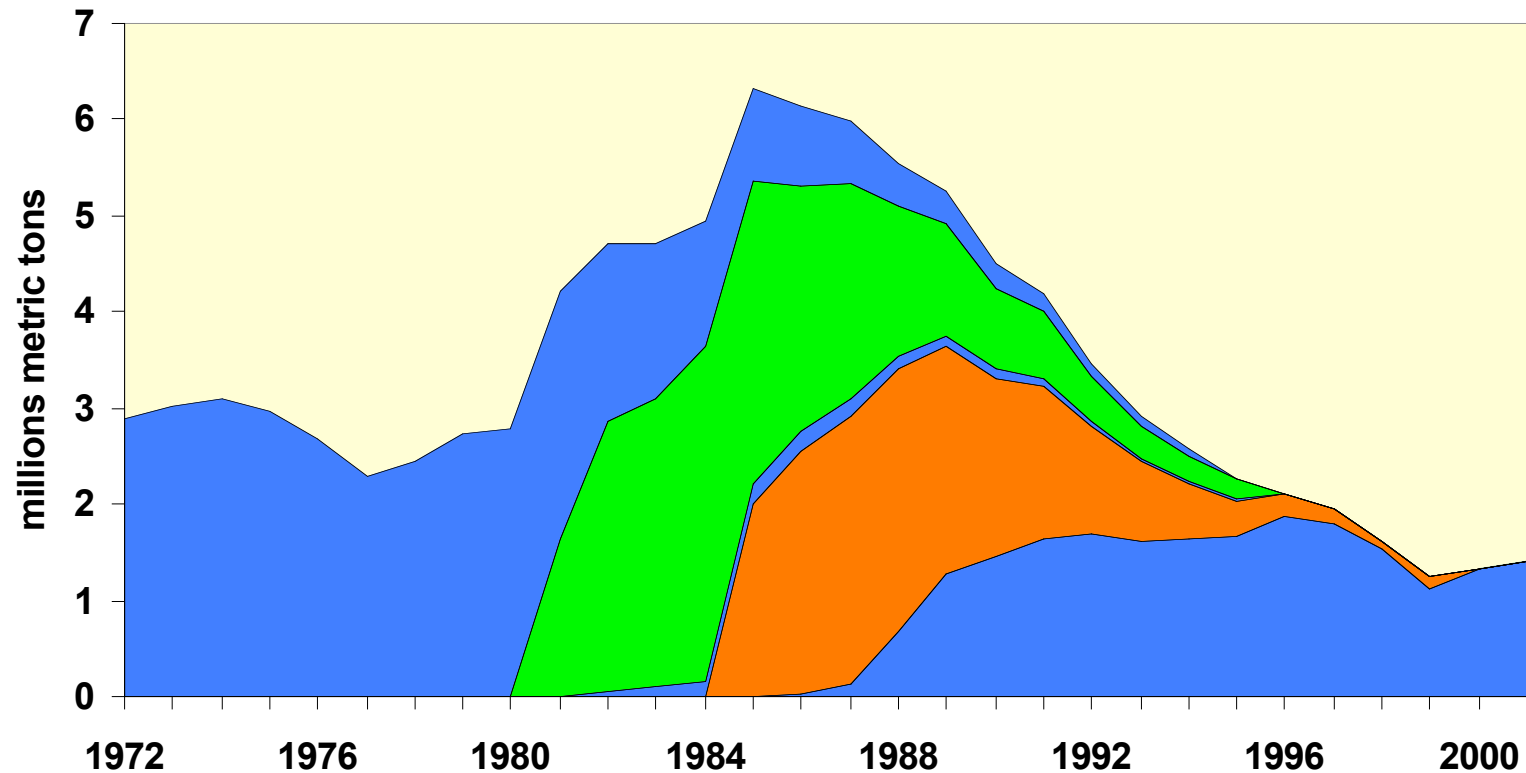
And the top down ...



Vera Agostini, Ph.D. dissertation, SAFS UW, 2005

Pacific hake biomass trajectory

Impact of the 1980 (green) and 1984 (orange) year classes on the total estimated standing biomass of Pacific Hake

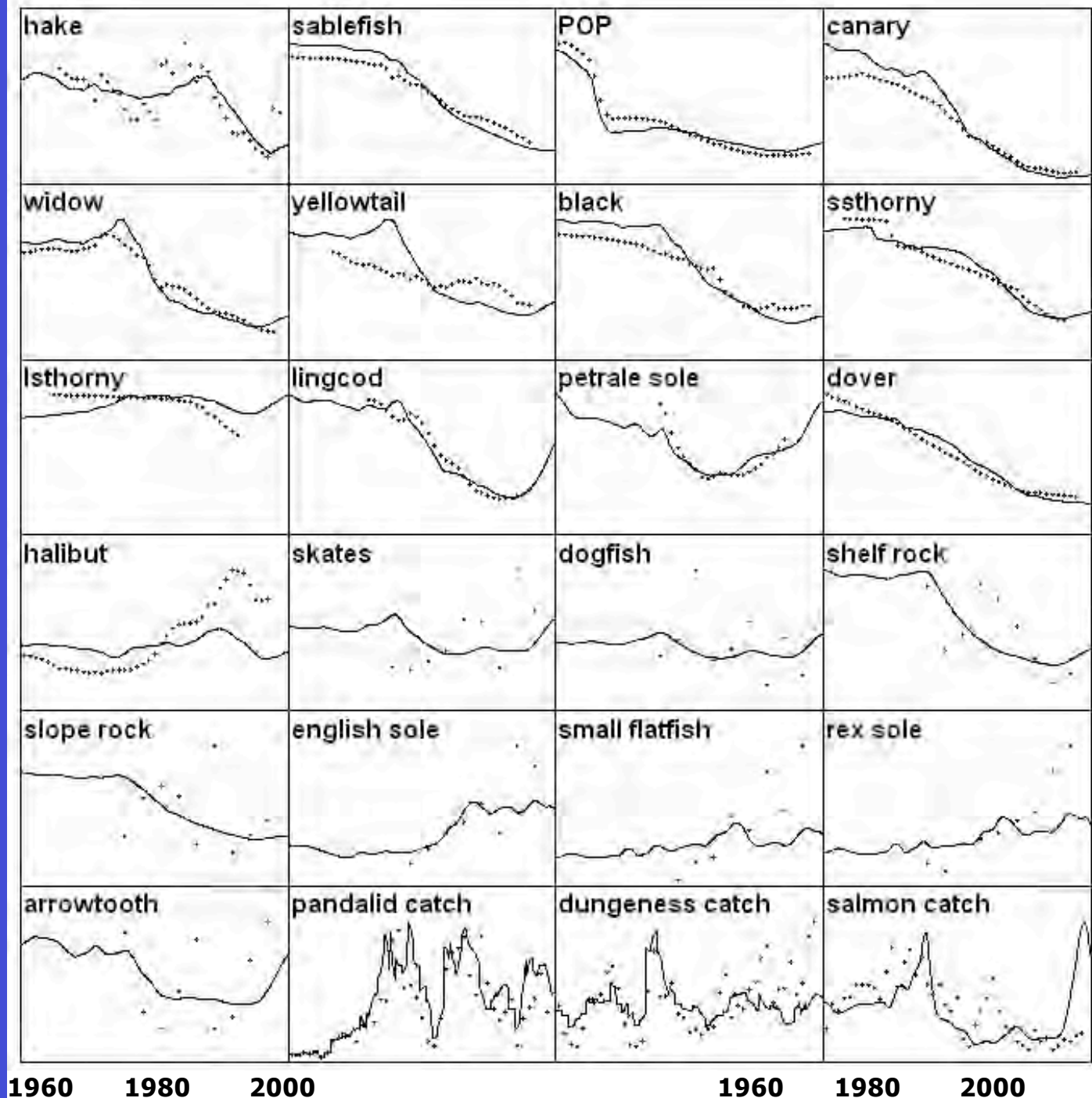


Model fitted to
assessment,
survey and
catch data
(1960-2002)
with both the
Logerwell index
(bottom-up) and
PDO (top-down)
forcing

Neg log like:
-379

no climate:
-352

John Field
Ph.D. dissertation
SAFS UW, 2004



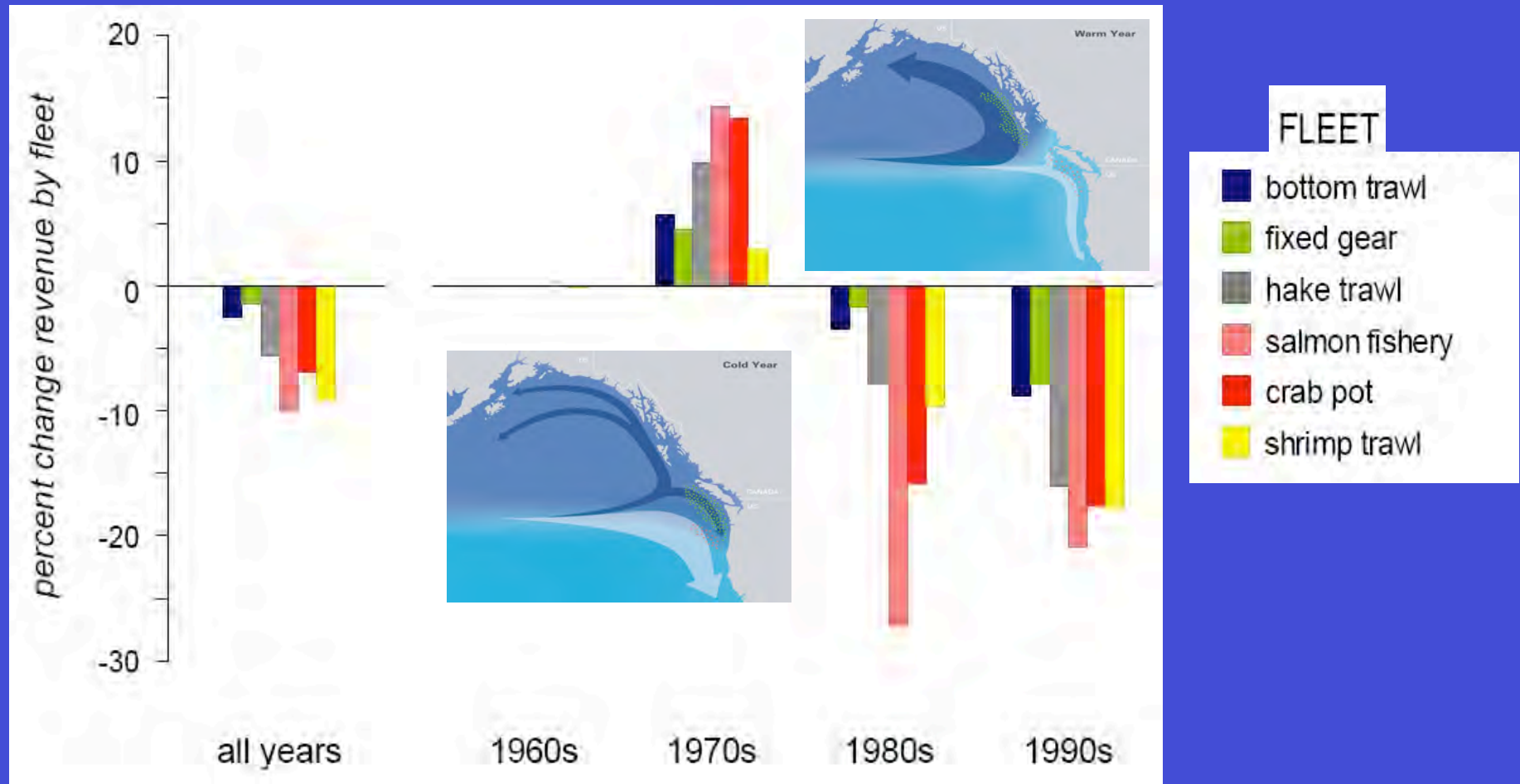
We can also explore the impact of climate on NCC fleet revenues



Coastwide Dockside Revenues (\$ millions)

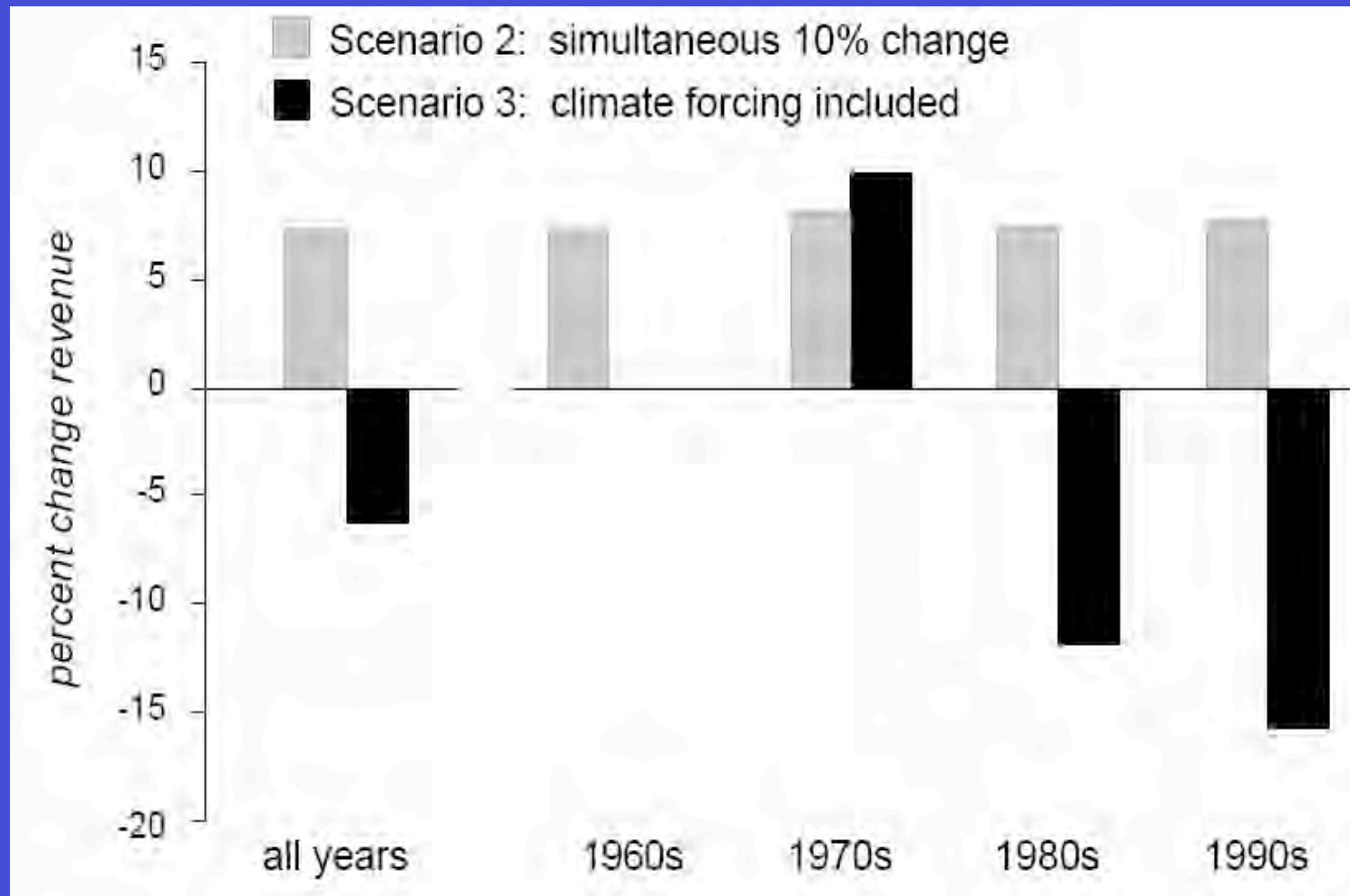


Fleet revenue effects of adding climate into model (1960-99)



Jodie Little, Ph.D. dissertation, SAFS UW, in progress

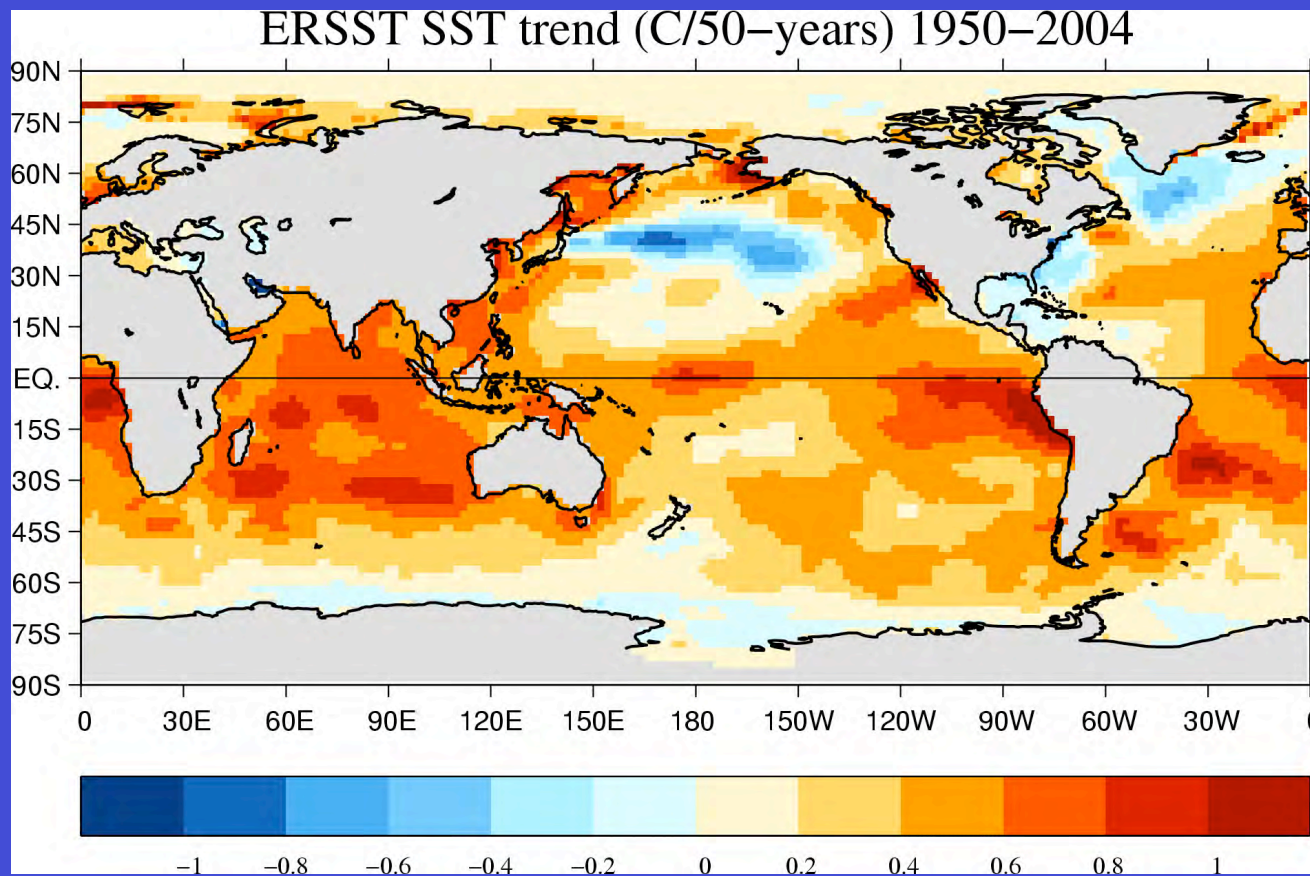
Climate vs fishing intensity effects on total revenues (1960-99)



Jodie Little, Ph.D. dissertation, SAFS UW, in progress

Some Recent Observations

55yr trends in Pacific SSTs



Since 1950 there has been a near-global warming of SSTs

subarctic N. Pacific SSTs have a cooling trend

(Figure created by Todd Mitchell, UW-JISAO)

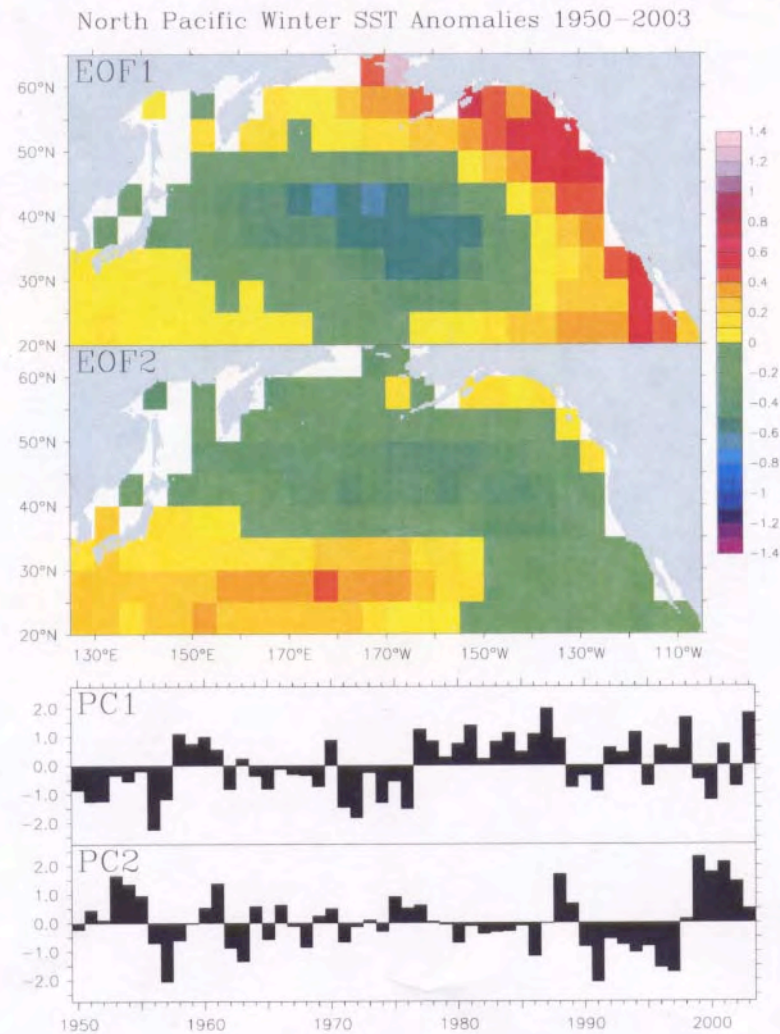


Figure 5. Principal Component Analysis of North Pacific winter (November–March) SST fields north of 20°. The first EOF (top) corresponds to the PDO pattern and its time evolution is given by PC1. The evolution of the second EOF pattern shows large magnitudes since the 1990s with a shift to large positive values for 1999–2002.

WDD Specific Oscillation

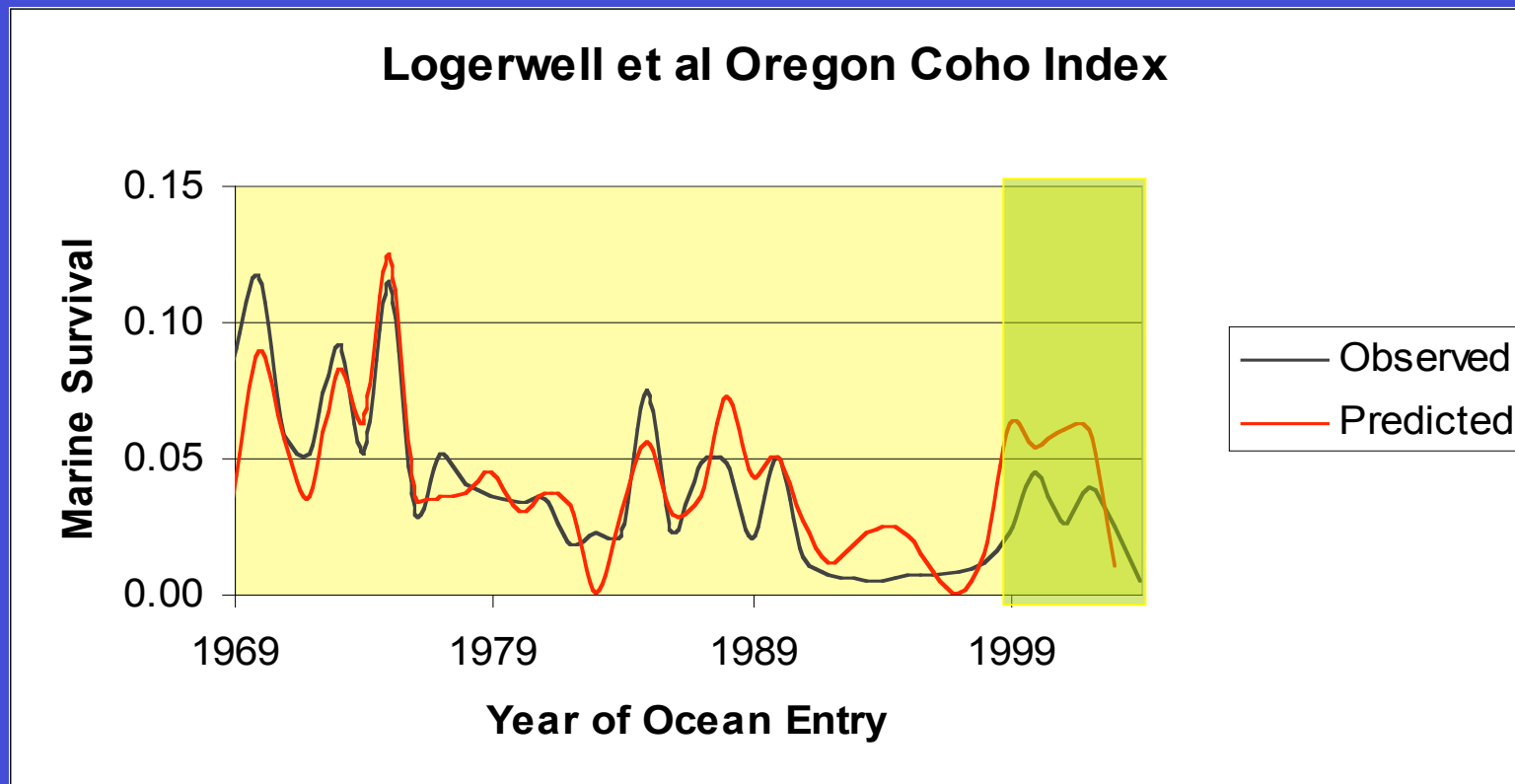
500 to 1000

negative phase

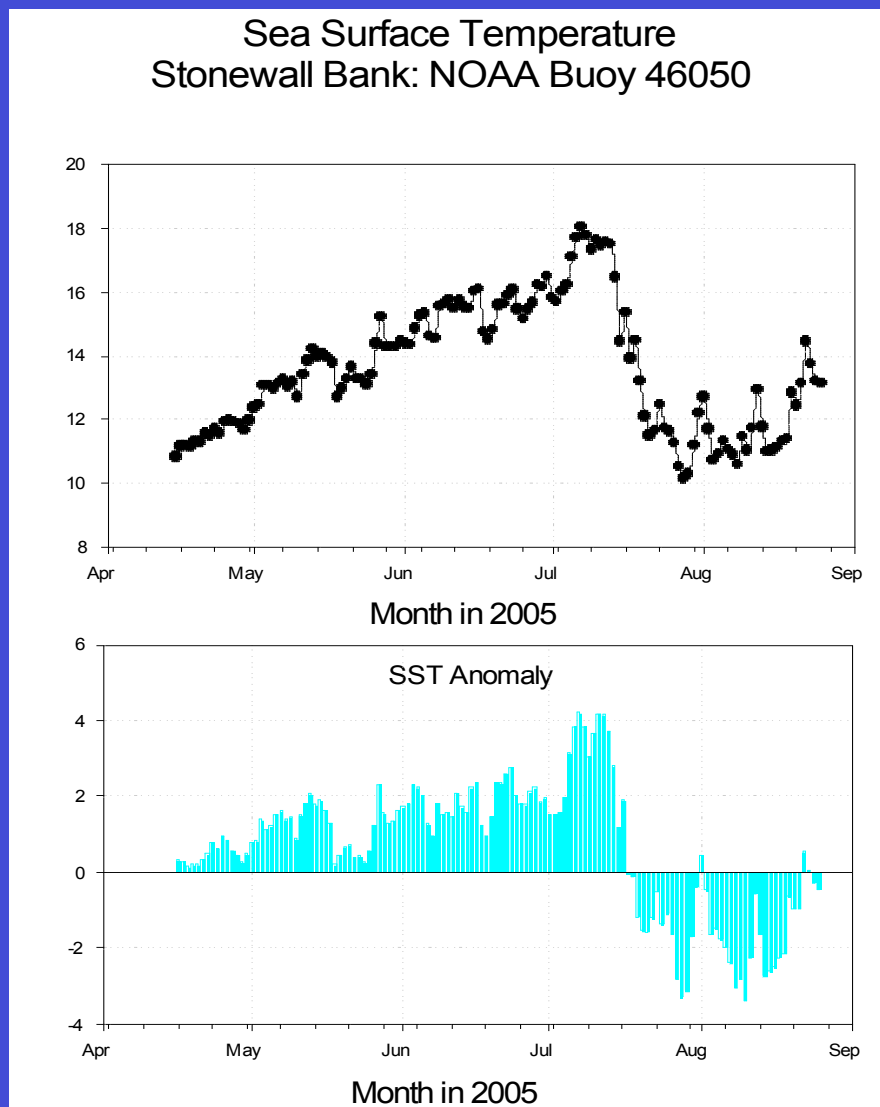


There's no more 

Oregon coastal coho index is on a wild ride



2005 was a very strange year off the Oregon coast



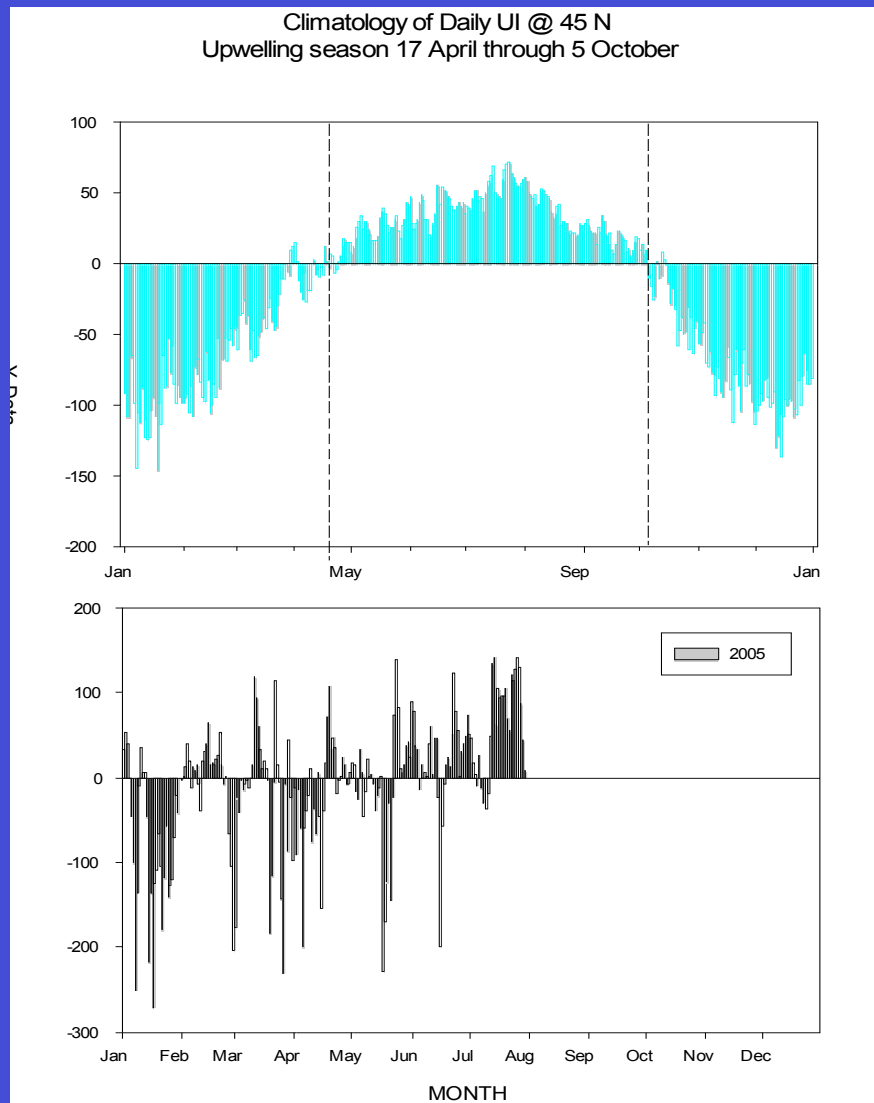
Anomalies based on 91-04 avg

Warmest ever June

Short but intense upwelling season (mid July - Aug)

(Bill Peterson, pers. commun.)

2005 was a very strange year off the Oregon coast



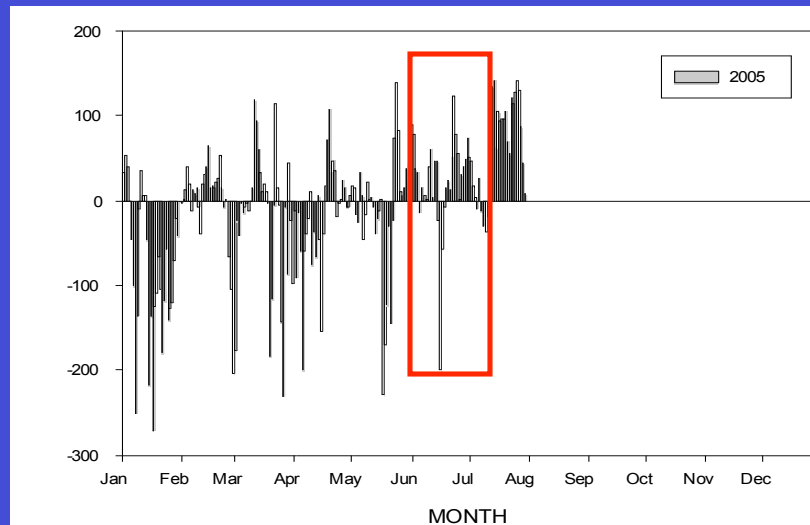
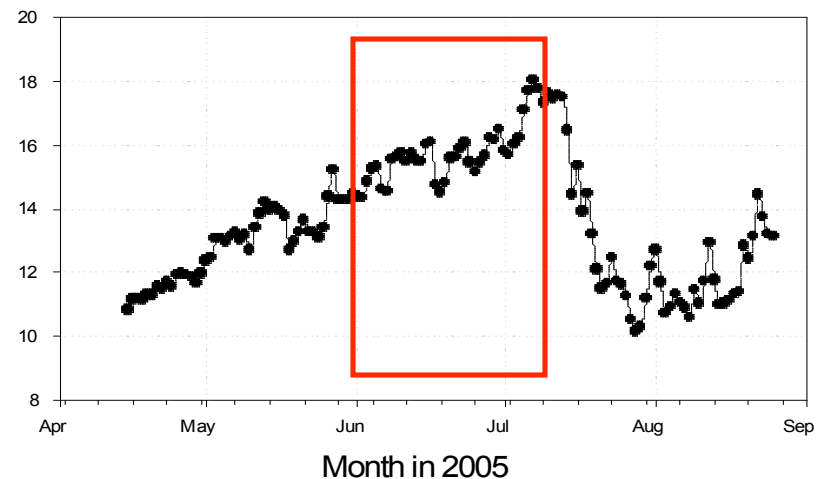
1967-2004 climatology
of daily upwelling
@ 45 deg N

2005 daily upwelling
@ 45 deg N

(Bill Peterson, pers. commun.)

2005 was a very strange year off the Oregon coast

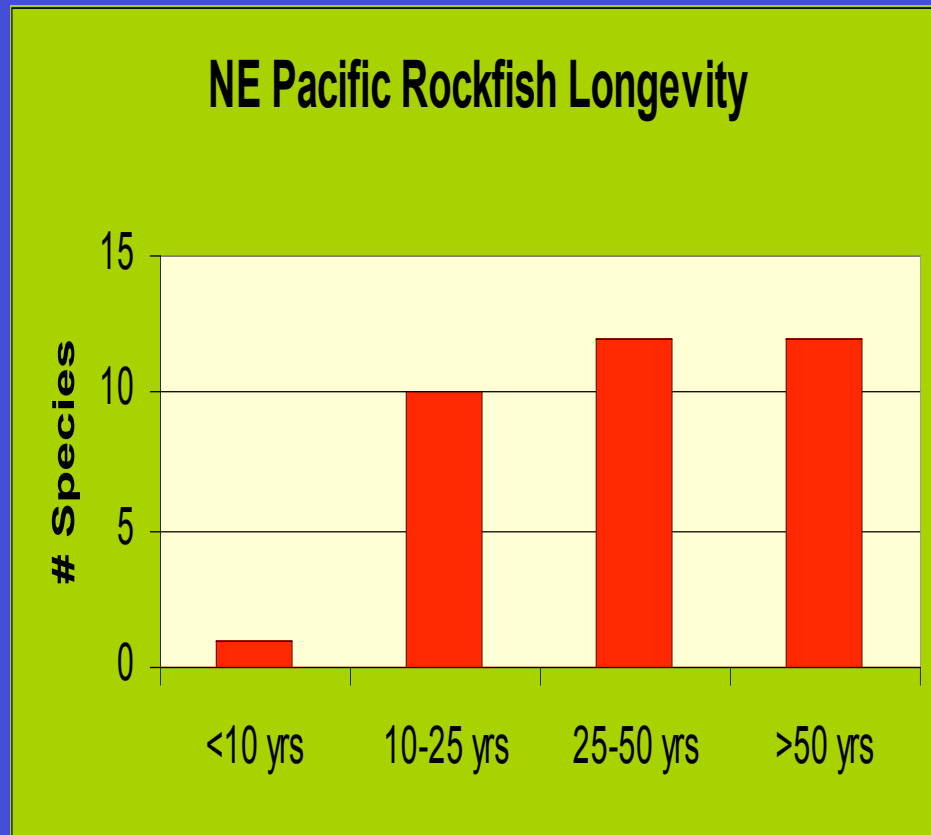
Sea Surface Temperature
Stonewall Bank: NOAA Buoy 46050



What to do about climate change?

Species have evolved very different ways of dealing with environmental uncertainty

Coastal Rockfish



Fisheries can easily disrupt those ways



North American Journal of Fisheries Management 4:465-468, 1984
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The Great Widow Rockfish Hunt of 1980-1982¹

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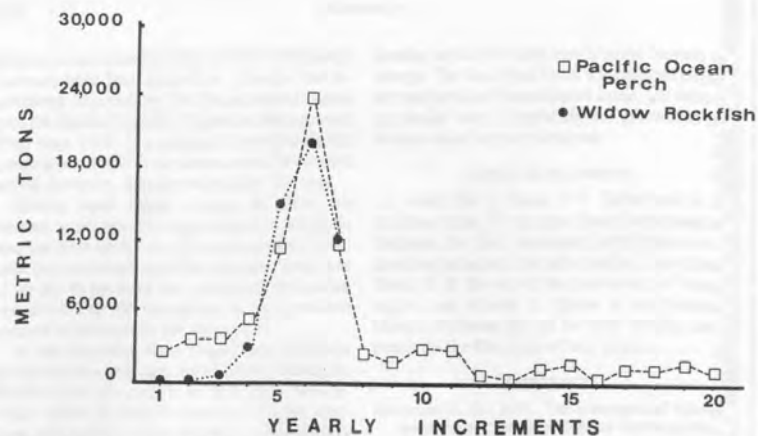
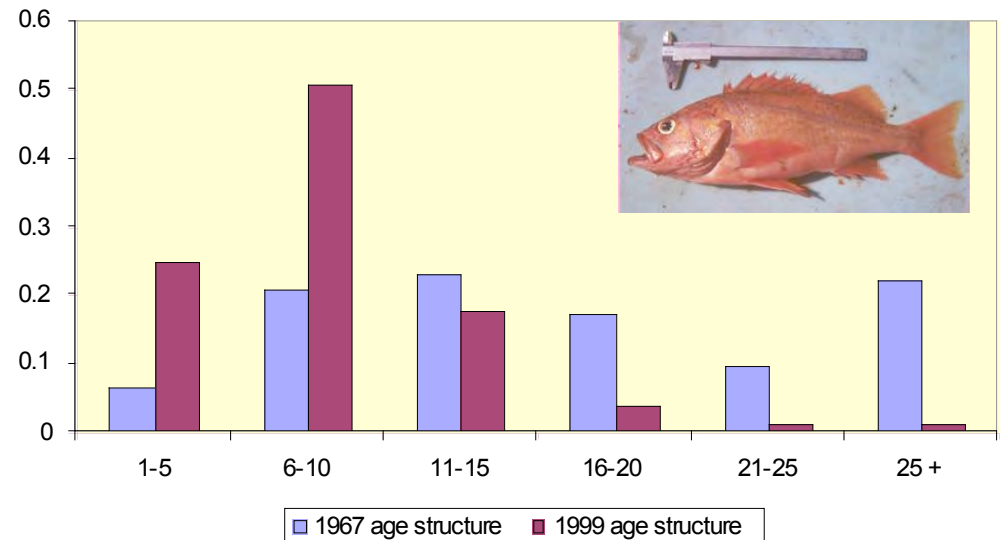


Figure 1. A comparison of the International North Pacific Fishery Commission (INPFC) Columbia area landings of Pacific ocean perch (1962-1981) and widow rockfish (1976-1982). From "Perspectives on the Pacific Coast Groundfish Fishery" prepared by the Groundfish Management Team, Pacific Fishery Management Council, November 1982.

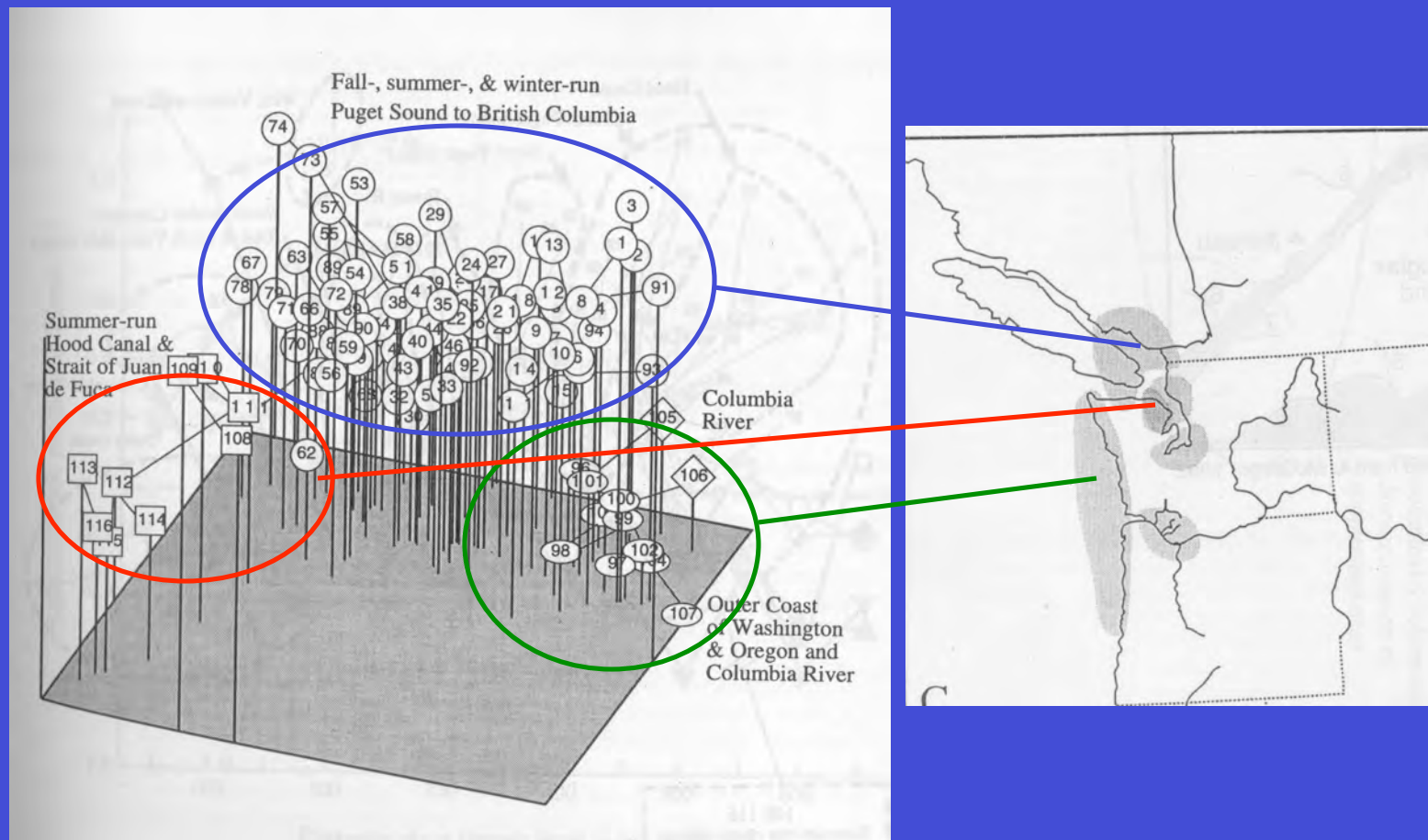
Changes in the age distribution of Canary rockfish



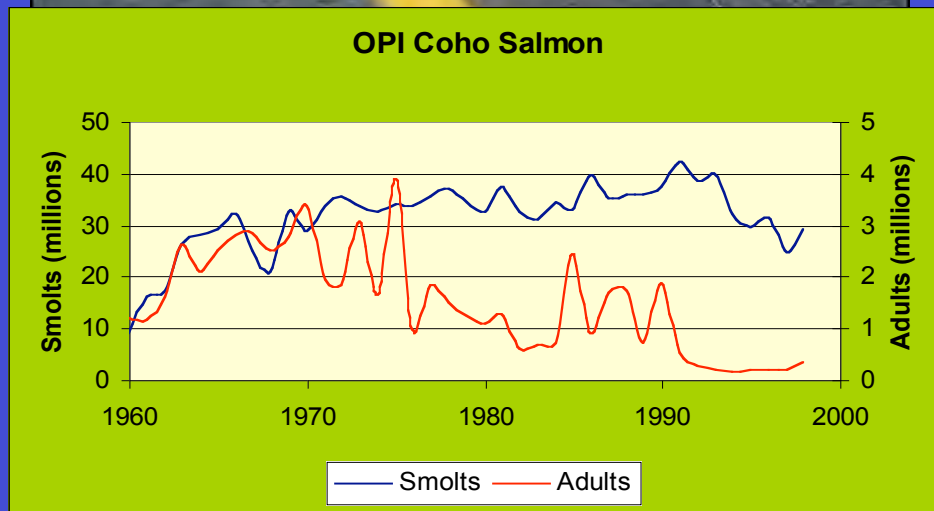
Berkeley
 et al.
 (submitted)

Species have evolved very different ways of dealing with environmental uncertainty

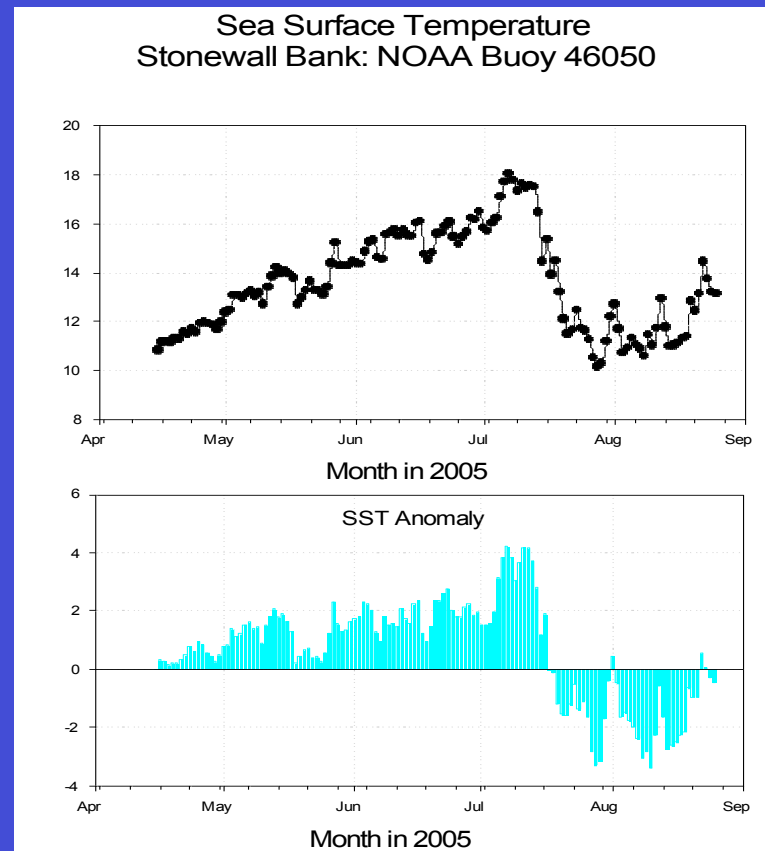
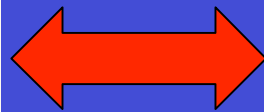
Pacific Salmon



Human industry can disrupt those ways



Genetic diversity is nature's sole insurance policy.
Environments change: Wet years are followed by droughts,
lakes dry up, volcanoes rumble, ice ages dawn. It's a big bad
world out there for a little strand of DNA. But a population
will persist over time if, deep within the scattered genetics
of its ranks, it is literally prepared for anything.
Barbara Kingsolver, A Fist in the Eye of God



What can natural resource management actually do about climate change?

- Become more aware of the effects of climate on coastal marine fisheries
- De-emphasize prediction
- Become more proactive
- Restore natural climate insurance by striving to retain critical types and ranges of variations in ecosystems (Holling and Meffe 1996)
- Focus as much attention on retaining biological structure as on maintaining resource abundance